LEPIDOPTEROUS LARVÆ FROM RAPID STREAMS.[1]

BY J. T. LLOYD,

ITHACA, N. Y.

The aquatic lepidopterous larvæ hitherto known are all inhabitants of quiet waters,—lakes, ponds or pools. Herewith are described three species of *Elophila* inhabiting swift waters, one species from N. Y. state and two from Colombia, S. A. In several ways they are unique. They are found in very swift flowing water where one finds the larvæ of net-spinning caddis-flies and the nymphs of stone-flies and may-flies. Here they live beneath sheets of silk spun over exposed surfaces of current-swept rocks. In structure their unbranched, filamentous gills, and expanded, fan-like setæ of the labrum and labial palpæ will distinguish these larvæ from any other described species. Their pupæ, unlike other lepidopterous pupæ known to us, are completely submerged. The life history and description of the larvæ and pupæ are given more in detail on the following pages.

Elophila fulicalis Clemens.

Habitat.—During the summer of 1911 larvæ of this species were found in Fall creek, about one mile east of the Cornell campus. At the place where they occur most abundantly the creek is very swift, flowing over a rough bottom of loose rocks. The depth at low water varies from less than an inch to more than two feet. During the spring freshets both depth and width are very greatly increased and the stream becomes a roaring torrent. The larvæ also occur, though in less abundance, in the swift water on the flat rock floor a short distance above and below the locality described. The bottom of the creek is deeply coated with diatomaceous ooze intermixed with a deposit of silt. This ooze is present on the upper and absent from the under surfaces of the rocks.

Cascadilla Creek, less than a mile distant from Fall Creek, is slightly smaller especially during the dry season. In other respects the two are very similar. In view of the fact that this larva inhabits only a limited area in Fall Creek and is absent in similar localities in

[1] Contribution from the Limnological Laboratory of the Department of Entomology in Cornell University.

Cascadilla Creek it seems evident that its distribution is extremely local.

Larval Habits.—During the spring and early summer of 1913 search was again made for the larvæ but none were found until July 20. The cases found at this time were entirely different from those taken from the same locality in August, 1913. It was later discovered that the 1911 larvæ were in pupa cases.

The larval cover, pl. 2, fig. 4, is a thin, flexible sheet of silk, irregular in outline and closely cemented to its support throughout the greater extent of its margin. At two or three places it is not attached, these openings allowing free circulation of water.

The size of the silk sheets, pl. 2, fig. 4, when first found varied from one half inch to more than two inches in length and were about one fourth inch in width. Some were simple, others showed irregular branches. On July 26 some sheets were five inches long and more than an inch wide. On the latter date two pupal cases, the first of the season, were found. These contained larvæ which had not started their inner cocoons. On July 30 larvæ were still more common than pupæ but by the 5th of August almost all had pupated.

It is probable that there are two broods in a single season for in the bottles containing pupæ and pupal cases were discovered several small larvæ of the same species which ranged from 3 to 6 mm. in length. These larvæ were not seen when collected, but probably were picked up with the pupal cases. Additional evidence of an earlier brood was given by the occurrence of several adults among the insects caught in a traplantern in June.

Food of the Larvæ.—The organic contents of the stomachs consisted entirely of algæ. Most abundant were *Scenedesmus* and fragments of filamentous Chlorophyceæ; diatoms and *Pediastrum* were also found, as well as a large amount of silt. It is surprising to note that in the stomachs the green algæ were in greater abundance than the diatoms, although in the ooze which surrounded the larvæ diatoms greatly outnumbered the green algæ.

Pupal Habits.—Shortly before the time of pupation the silk sheets are removed and a cover of an entirely different nature is formed. This removal of the silk sheets leaves clean scars on the rocks, pl. 2, fig. 5, which in color, contrast strongly with the surrounding diatomaceous coating. Within these scars, sometimes in the center, some-

times on the edge, the pupal cases are located. The cases, pl. 2, figs. 5, 6, are oval in shape, about three quarters of an inch long and half an inch wide and are elevated about one tenth of an inch above their support. Their roofs are flat and are supported by perpendicular side walls which are perforated at each end by six or more clean-cut holes to permit free circulation of water. The inner pupal case consists of a sheet of loose-spun silk. Radiating threads attach the cocoon to the roof but, as in the case of the larval sheets, there is no silk floor over the surface of the rocks. The pupal cases, unlike the larval sheets, are spun of thick inflexible layers of silk and, also unlike the larval sheets, become thickly coated with diatomaceous ooze.

Period of Emergence.—The first adults were seen August tenth. By August seventeenth they had reached their maximum numbers, fairly swarming as one walked through the vegetation along the water edge, but seldom occurring more than a few yards from the stream. By August twenty-eighth no adults could be found.

DESCRIPTION OF LARVA AND PUPA.

Larva.—The length of mature larva, Pl. III, fig. 1, is ten to eleven mm., its form is depressed tapering gradually from its head to the end of its tenth abdominal segment. Its color is dark straw-brown. The unbranched, hairlike tracheal gills form a double row along each side of the thorax and abdomen. The upper line of gills is plainly suprastigmatal in position and the lower line is infrastigmatal. The arrangement and distribution of the gills makes it impractable to apply the other terms, anterior- and posterior-stigmatal, used by Forbes in "The Aquatic Caterpillars of Lake Quinsigamond," Psyche, December, 1910.

Head.—Almost circular in outline, heavily chitinized, its diameter at least as great as any segment of the body. A narrow, heavily chitinized band, Pl. III, fig. 4, along the posterior side of the frons forming a conspicuous dark brown V shaped mark. A similar band borders the hind margin of each epicranium. The middle pair of setæ on each lobe of the labrum, Pl. III, Fig. 2, are modified into thin, transparent, fan-like plates with irregular margins at the distal, or broad, end of the fans. Their bases are heavily chitinized, circular in outline and resembling the bases of ordinary setæ. They arise

from setigerous punctures. The terminal setæ of the labial palpæ are dialated, Pl. III, figs. 3 and 5. The arrangement of setigerous punctures on the labrum is shown in Pl. III, fig. 2; on the head in Pl. III, figs. 3 and 4.

Thorax.—First thoracic segment heavily chitinized and without gills. Second and third segments thinly chitinized and with a single group of from two to five unbranched gills above each leg. The distribution of setæ on the dorsum is shown in fig. 1, Pl. IV. On the ventral side there are numerous small setæ, which are especially abundant on the legs.

Abdomen.—The first eight abdominal segments have filamentous, unbranched gills distributed in two rows, supra- and infra-stigmatal in position. The supra-stigmatal gills occur in groups of from two to four near the cephalic border of the segment. Variation in the number of these gills occurs in different individuals, and even on the two sides of the same segment of the same individual. A single supra-stigmatal gill may be present near the caudal margin of any abdominal segment. This gill, when present on one side, may be absent from the other side of the same segment. The infra-stigmatal gills are arranged in a single, nearly straight row, along each side of the first nine abdominal segments. From three to five of these gills occur on each segment, arising from lateral folds of the body wall. On one specimen in my possession a single dorsal gill is present near the caudal border of the ninth abdominal segment, midway between the mid-dorsal line and the lateral margin. The tenth abdominal segment is without gills and is roundly bilobed at its caudal extremity. On abdominal segments three to six, inclusive, there are oval prolegs, each ending in a terminal ring of about thirty-two hooks. Long and short hooks alternate on these circles. On the last abdominal segment the prolegs are more oval in outline than on the preceding segments and the hooks, about fifteen in number, are arranged in a single line with their bases pointing cephalad, instead of forming a circle as on the other segments.

Young Larvæ.—The young larvæ have noticeably fewer gills than old larvæ. The smallest specimen in my possession (length 3 mm.) has as many as four infrastigmatal gills on only one side of one segment. Other clusters of infrastigmatals are composed of three or two gills. The superstigmatals also average fewer than on the mature

larvæ, two being not an uncommon number for a cluster. Otherwise the young larvæ agree in structure with the mature larvæ.

Pupa.—Pl. III, figs. 6 and 7. Length 6 to 7 mm., breadth 2 mm. Color of alcoholic specimens, head and thorax dark brown above, appendages lighter, except caudal margin of wing-pads, which are dark. Abdominal segments dark brown above ringed with cream color at the edges of segments, sides and venter of abdomen cream color. Anal anchor dark brown, almost black. Third and fourth abdominal segments with large tubular spiracles surrounded by a light area which is encircled by a narrow chitinous band. Vestigial spiracles are visible on abdominal segments 5 to 9, inclusive. Vestigial prolegs are on abdominal segments 6 and 7. The strongly chitinized abdominal anchor measures one mm. from tip to tip. The positions of setæ are shown in Pl. III, figs. 6 and 7.

TWO ALLIED SPECIES FROM COLOMBIA, SOUTH AMERICA.

Besides the species, *Elophila fulicalis,* from New York State two species of lepidopterous larvæ were taken from a swift stream in Colombia, South America. These larvæ are so similar to the one previously described that a brief description is included here.

Species *A,* the smaller of the two, measures six mm. in length and a half mm. in breadth. Its form, unlike the other species which is greatly depressed, is almost cylindrical. In color the alcoholic specimen is uniformly dark brown, except the gills which are slightly lighter, some gills being encircled near the middle by a single band of black. They are arranged in supra- and infra-stigmatal series as in *Elophila fulicalis* and, as in that species, are not alike in number on the two sides. Also unlike *E. fulicalis* the gills of both the supra- and infra-stigmatal series are arranged in anterior and posterior groups, but these groups may vary in number on the two sides of the same individual or may be entirely wanting. The first thoracic segment bears no gills, the second and third thoracic segments bear supra and unlike *fulicalis,* infra-stigmatal gills. This larva has a group of five dorsal gills on the posterior border of the ninth abdominal segment midway between the lateral line and the lateral margin Pl. III, fig. 10.

The head in form is much more rounded than *E. fulicalis.* The labrum is shown in Pl. 2, fig. 7. Four setæ on each side are broad-

ened at their distal ends and two setæ are pointed, but these latter, like all setæ of the head, are flat. A small area on the tip of each lobe is covered with fine, short hair. The mandibles, Pl. IV, fig. 8, are short, heavily chitinized and not deeply notched. The frons is glabrous and without pattern. Its two middle setæ are nearer to each other than to the lateral setæ.

The thorax has the first segment heavily chitinized, with a well marked dorsal suture along the median line. A row of five setæ is visible from above on each side of this segment. The second and third segments are not heavily chitinized. Each of them has a single dorsal seta in front of the gills and nearer the median line. On the ventral side each thoracic segment bears a strong seta outside of each coxa.

The abdomen has circular prolegs on segments three to six inclusive and oval prolegs bearing a single line of hooks on the last segment, as in *E. fulicalis*. On the dorsal side there is a single seta back of each group of anterior stigmatal gills, and on the ninth segment a crescentic line of six setæ. On the caudal border of the last segment there are four strong setæ, Pl. IV, fig. 10.

Only one specimen of this species was found.

Species *B*, the larger South American larva, measures fifteen mm. in length and three mm. in breadth. Its form is more depressed than the small South American species but less flattened than *E. fulicalis*. In color it is uniform brown with lighter gills. Its gills follow the same general arrangement as the preceding species. The infra-stigmatal gills are not present on the second and third thoracic segments. On the abdomen they form a continuous line on each segment, rather than forming groups, as in the other Colombian species. The supra-stigmatals are absent from the first thoracic segment, but present on all other segments, except the last abdominal. The gills are more numerous than on either of the two preceding species, as many as eighteen being present on one side of some segments. In number they vary greatly.

The head is more flattened than the head of the other South American species. The frons and adfrontals are glabrous and have a color pattern of minute dark hexagons. Other parts of the head are glabrous and without pattern. The labrum has three setæ on each lobe flattened and expanded at their distal ends. The distribution of

hair and setæ is shown in Pl. IV, fig. 2. The four setæ of the frons are equidistant from each other and the end punctures are the same distance from the margin as from each other.

The thorax has the first segment heavily chitinized and has two lateral humps corresponding in position to the supra- and infra-stigmatal gills of the following segments. Each of these humps is tipped by a strong seta. These setæ and about five others on each side complete a line across the dorsum. Two other punctures are present behind this line of setæ, the more caudal one being the farther from the median line. On the ventral side of the thorax there are numerous small setæ, especially abundant on the legs.

The abdomen is widest at about its third segment and from there tapers gradually to the tip. Prolegs are borne on the third to sixth abdominal segments and on the tenth. Those of the tenth segment are well developed, point caudad and are plainly visible from above, Pl. IV, fig. 3. A few small setæ are present among the supra-stigmatal gills. Other well developed setæ on the dorsal side are represented in Pl. IV, fig. 3. On the ventral side there is a line of four setæ across the ninth segment and several small setæ are present at the base of each proleg.

Five specimens of this species were taken.

The pupa of this species is much like that of *E. fulicalis,* the most noticeable difference being the presence of two wart-like prominences bearing strong setæ on the cephalic margin of the head. The setæ on the abdomen are longer and stronger and the caudal anchor has a longer shank. Also the appendages are longer in proportion to the total length of the body. The cast larval skins found in the cases with these pupæ furnished sufficient characters for identification.

Both species of South American larvæ were found in a swift Andean stream that flows into the Cauca River about half way between the cities of Cali and Popayan. They were collected on the 19th of February. At that time the larvæ collected were taken from the cases represented in Pl. IV, figure 1. Since many pupæ and one empty pupal skin were found it is evident that the imagos were then emerging, but larval cases may have been present and overlooked, for at that time we were not familiar with these sheets. The pupal cases Pl. IV, fig. 1, are similar to those found in Fall Creek but have more flaring edges and the perforations, which are farther from the edge,

form a complete oval on the top rather than on the side of the case. These perforations are more symmetrical than those of *E. fulicalis*.

EXPLANATION OF PLATES.

PLATE III.

Fig. 1. *Elophila fulicalis*, larva.
Fig. 2. *Elophila fulicalis*, larva, labrum.
Fig. 3. *Elophila fulicalis*, larva, maxilla and labium in part.
Fig. 4. *Elophila fulicalis*, larva, head, dorsum.
Fig. 5. *Elophila fulicalis*, larva, labial palpus.
Fig. 6. *Elophila fulicalis*, pupa, ventral.
Fig. 7. *Elophila fulicalis*, pupa, lateral.

PLATE IV.

Fig. 1. Pupal case of *Elophila* sp. *B*.
Fig. 2. Labrum of *Elophila* sp. *B*.
Fig. 3. Abdomen of *Elophila* sp. *B*, dorsum.
Fig. 4. Larval sheet of *Elophila fulicalis*.
Fig. 5. Pupal case and outline of larval sheet of *Elophila fulicalis*.
Fig. 6. Pupal case of *Elophila fulicalis*.
Fig. 7. Labrum of *Elophila* sp. *A*.
Fig. 8. Mandible of *Elophila* sp. *A*.
Fig. 9. Mandible of *Elophila* sp. *B*.
Fig. 10. Abdomen of *Elophila* sp. *A*, dorsum.

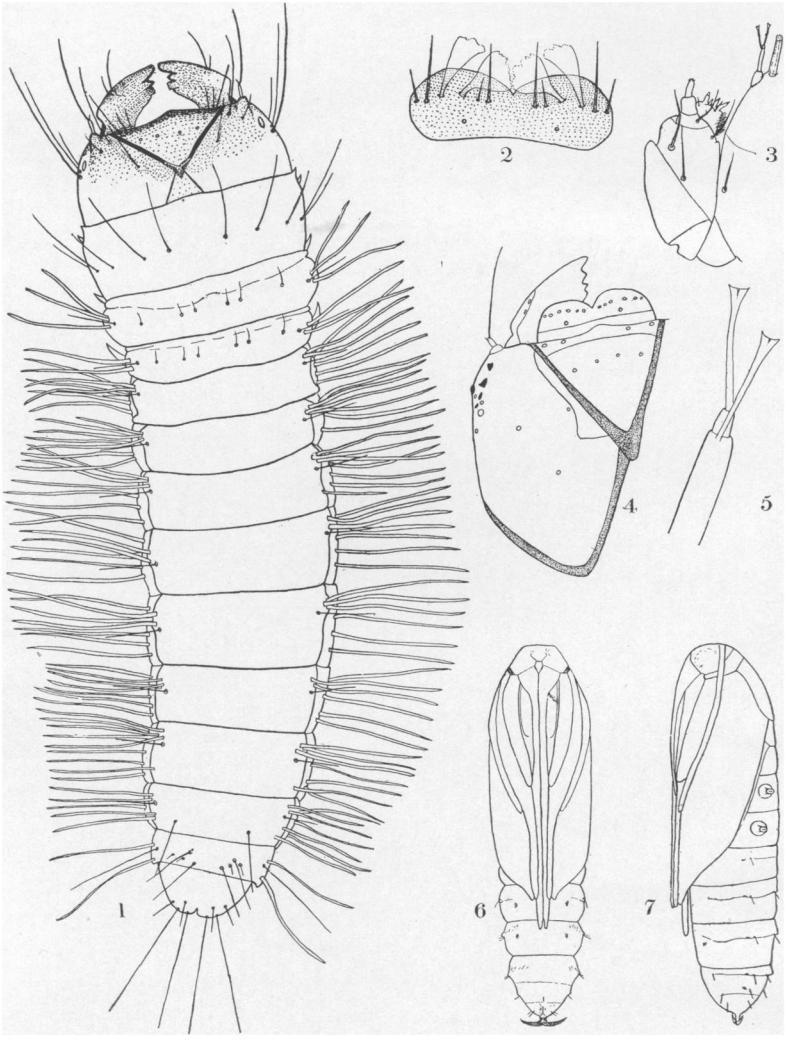
ERYCINIDÆ AND LYCÆNIDÆ FROM THE ISLAND OF TRINIDAD.

BY WILLIAM PHILLIPS COMSTOCK,

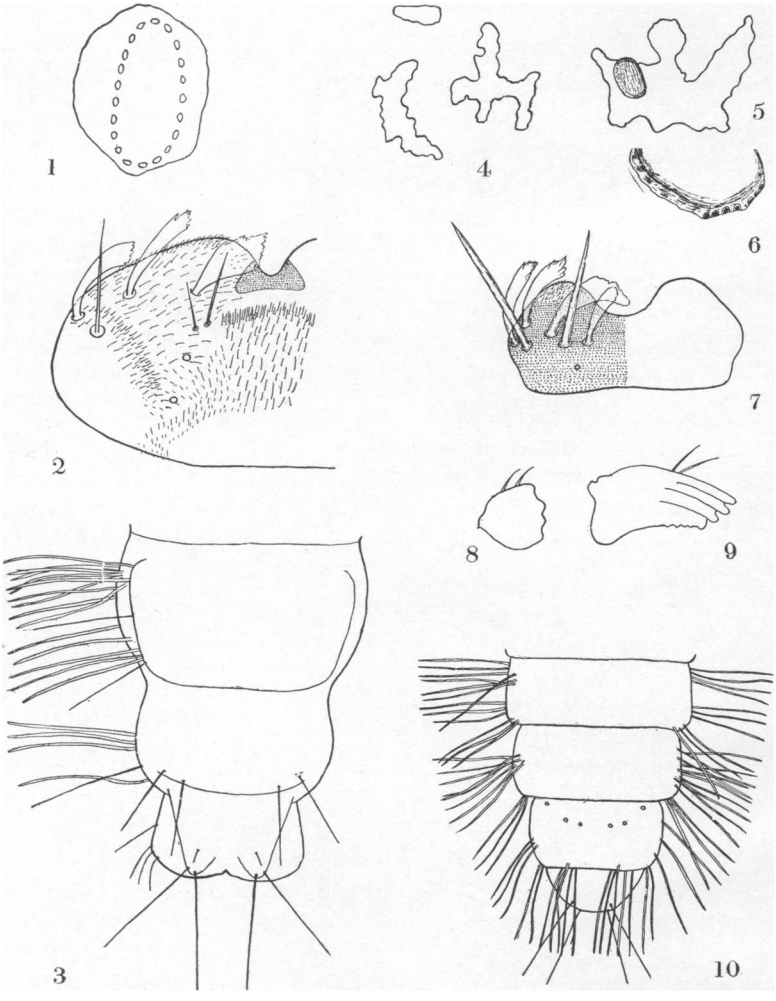
NEWARK, N. J.

My attention was first attracted to this subject on receiving a small consignment of butterflies from the island, all caught in one day by H. S. Parish. He says of the collecting:

"Trinidad lies about 16 miles from Venezuela eastward and is just above the 10th degree of latitude. Its average length is about 48 miles and breadth 35 miles. The largest town and principal port is Port of Spain. Being so near Venezuela it is a very productive place for the naturalist. I arrived just when the sun was rising, and



Aquatic lepidopterous larva.



Aquatic lepidopterous larva.